Electronic Supplementary Information for

Multioxide combinatorial libraries: fusing synthetic approaches and additive technologies for highly orthogonal electronic noses

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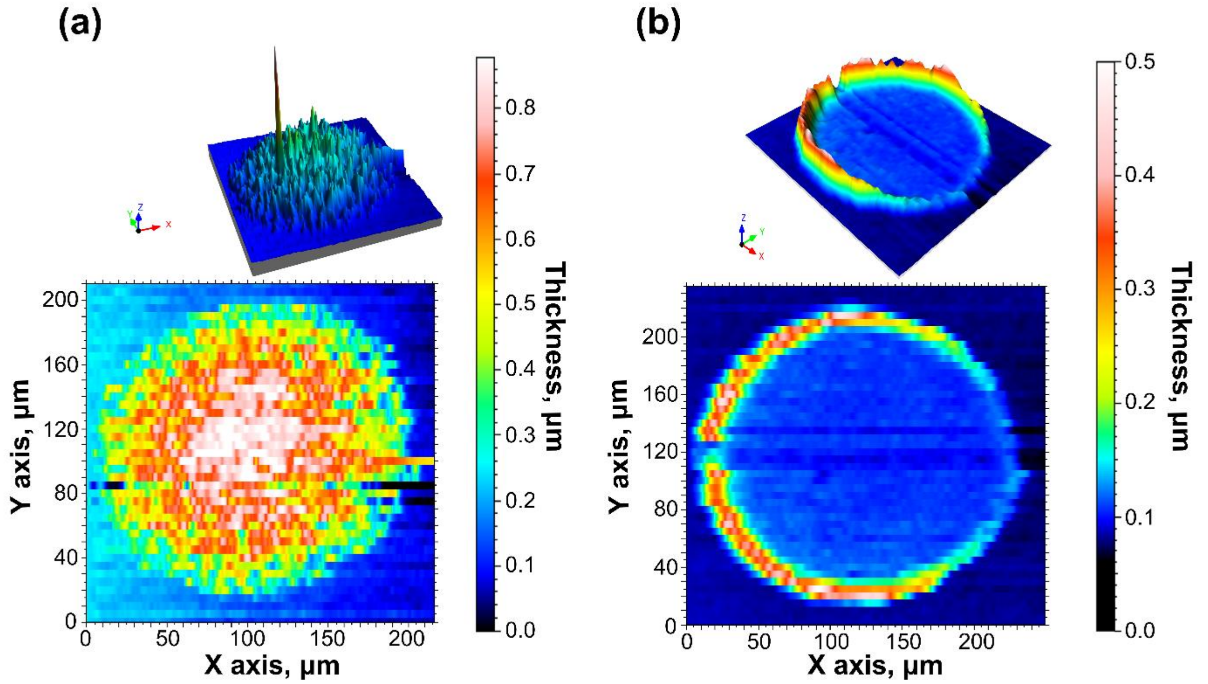

Figure S1. 3D mapping obtained by stylus profilometry for microplotted pixels of (a) Co_3O_4 and (b) NiO #2 sensing materials.

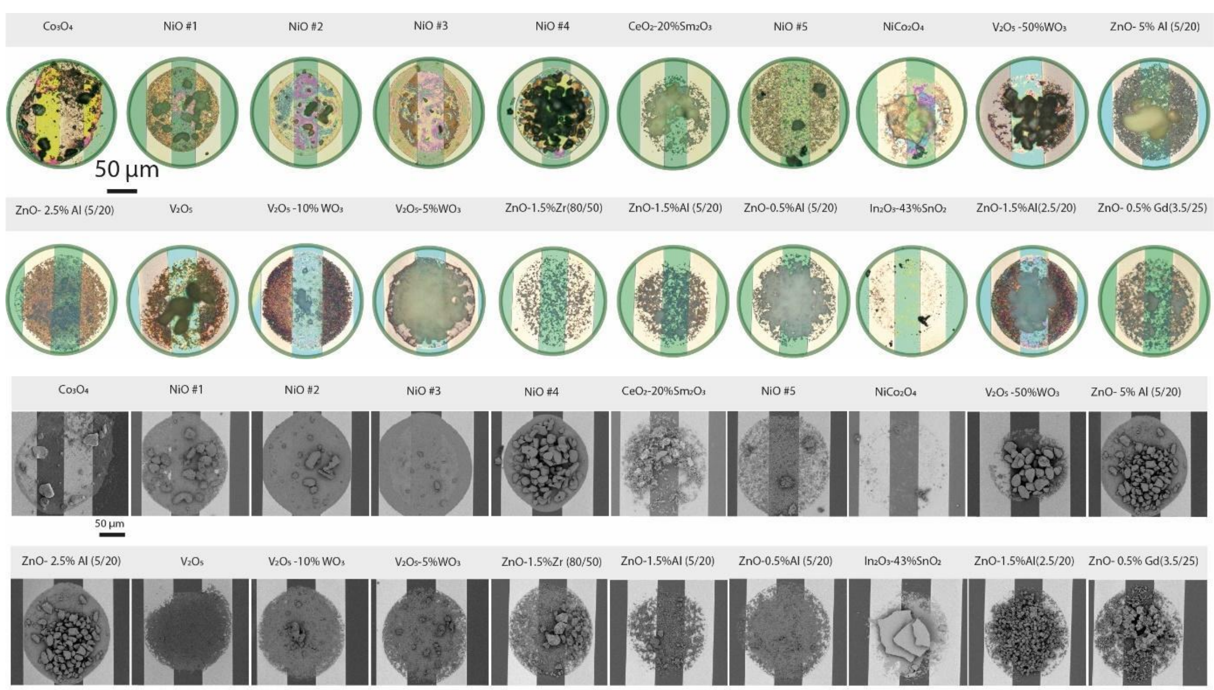

Figure S2. Optical and scanning electron microscopy images of all tested materials plotted on chips.

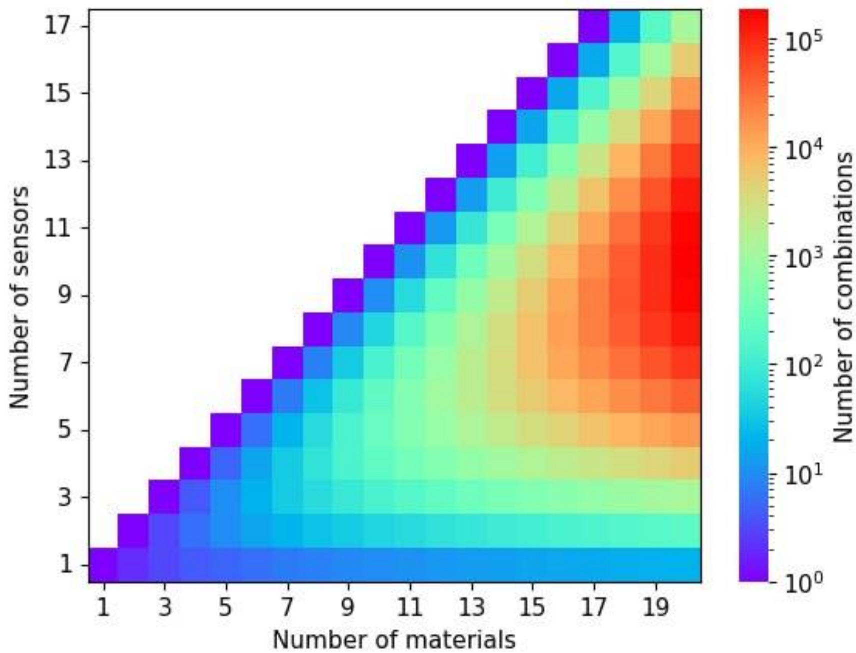

Figure S3. A number of combinations depending on the number of sensors *versus* the number of materials.

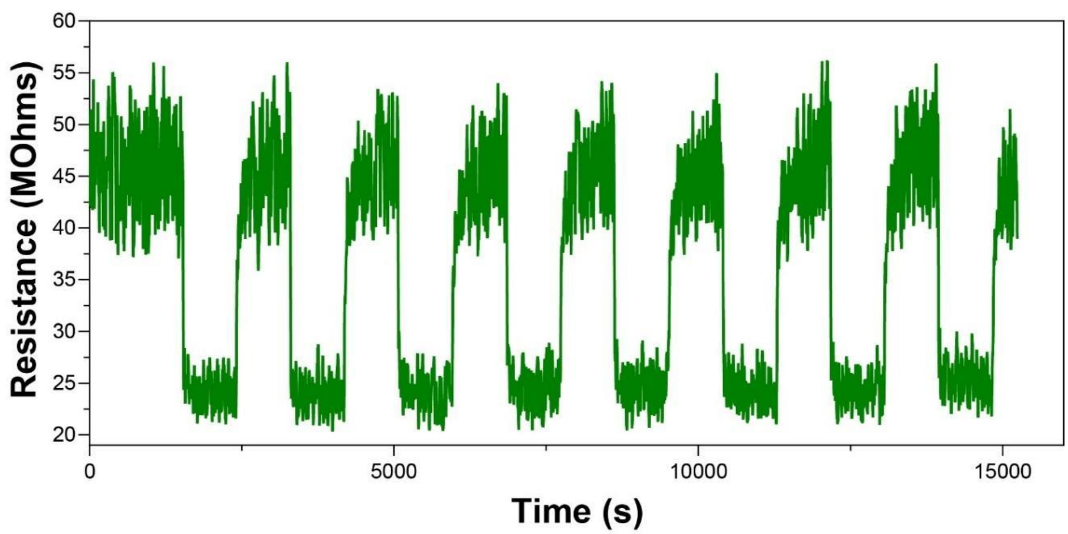

Figure S4. Representative resistance transient of In_2O_3-43%SnO_2 sensor over several sequential exposures towards ethanol, 2.6 *ppm*, in air. The moving average with the window size of 5 was applied to deal with the rather pronounced noise level indicated for this particular sample.

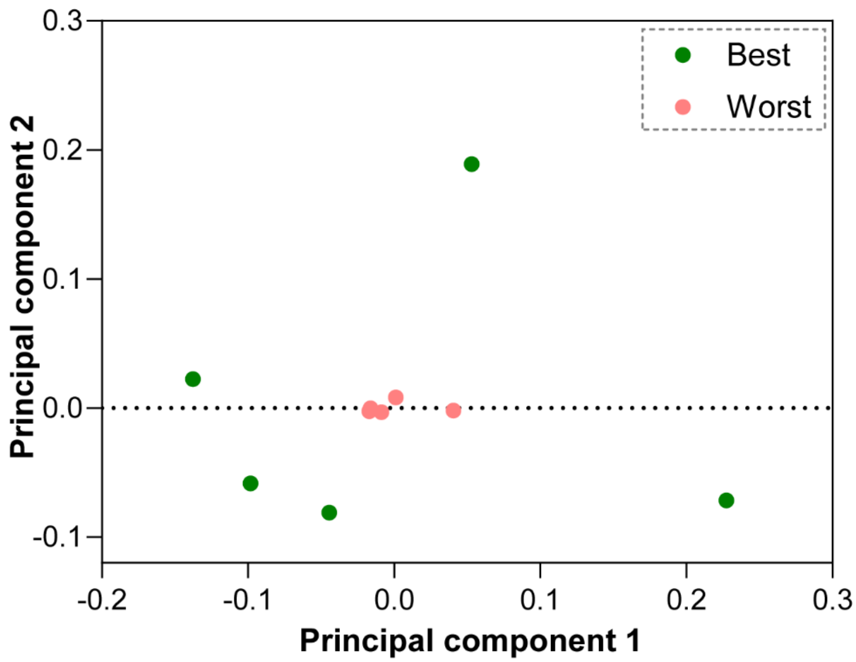

Figure S5. Representation of two-dimensional PCA transformation applied to the results from the “best” and the “worst” combinations of sensors across all the possible combinations from 3 to 20 sensors on a chip.

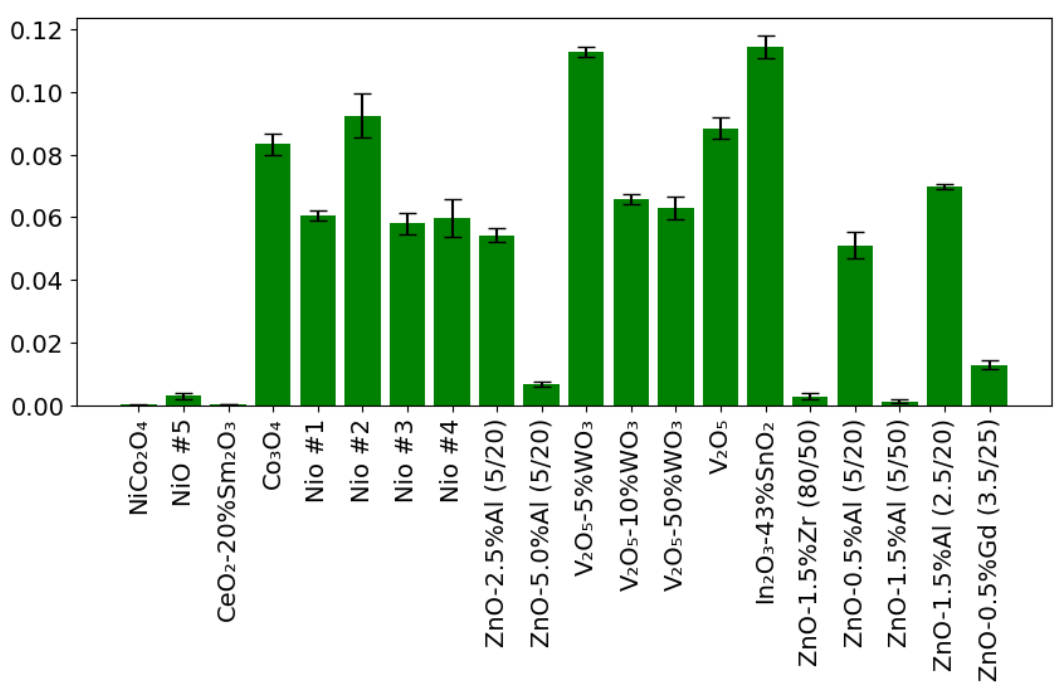

Figure S6. Feature importance of all the materials obtained using *Random Forest* classifier.

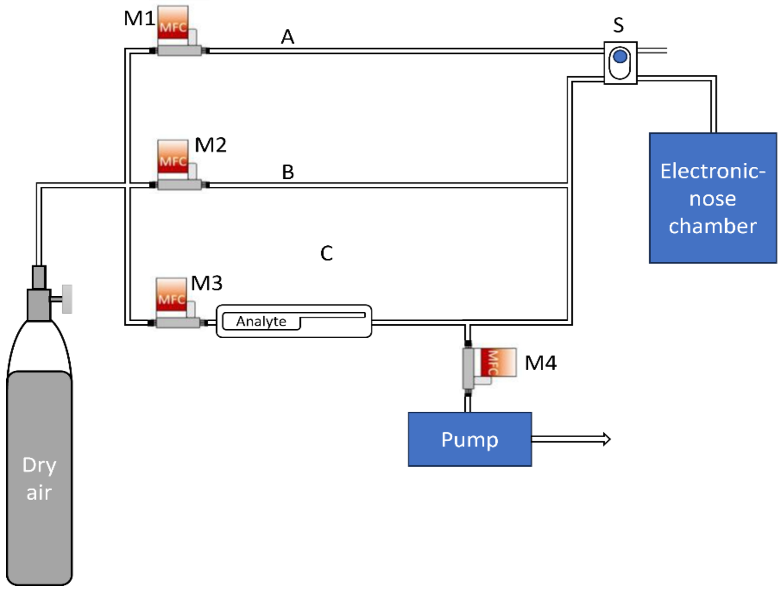

Figure S7. Gas analysis setup. M1, M2, M3, and M4 are mass flow controllers. A is the channel for the reference gas. B is the channel for the gas to control the concentration of the analyte. C is the channel for the concentration. S is the switch to toggle between the reference and the target gas. A pump is used to take out the excessive gas from the system.

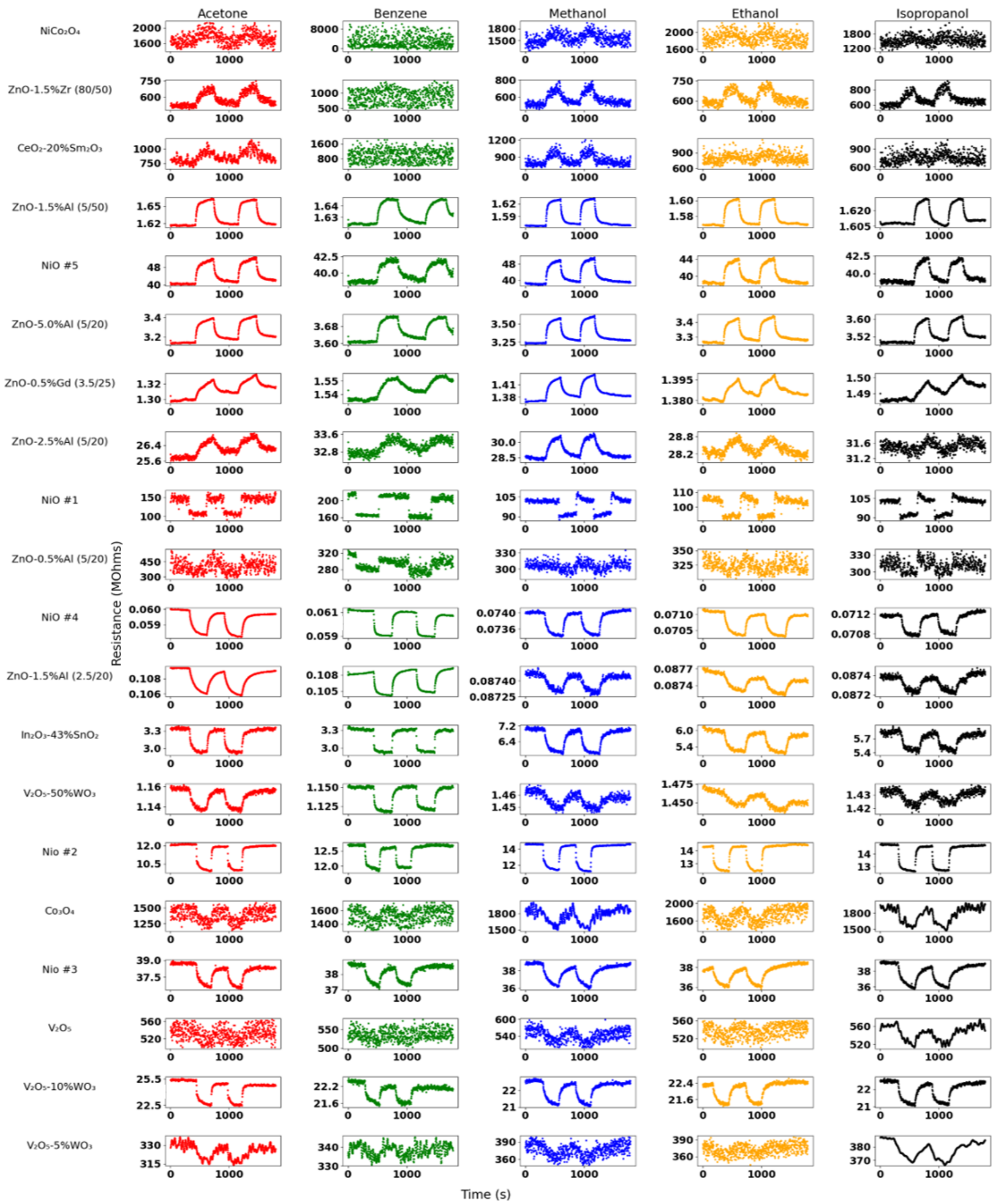

Figure S8. Resistance transients of the 20 materials towards the five analytes in dry air at 300 °C. The concentration of analyte is ca. 1 *ppm* in the mixture with air. The exposure to analytes was repeated two times, and the recovery time was adjusted depending on material performance.

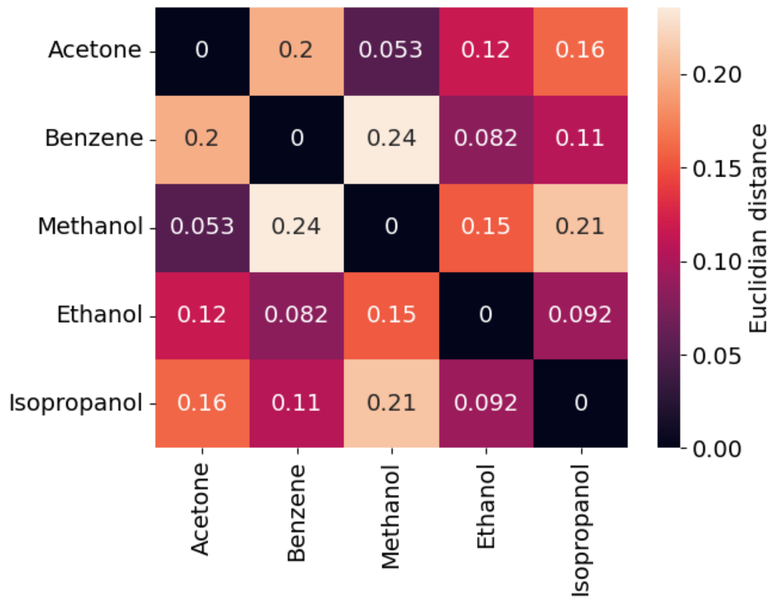

Figure S9. The distances between the clusters of analytes obtained from the “most important” materials.

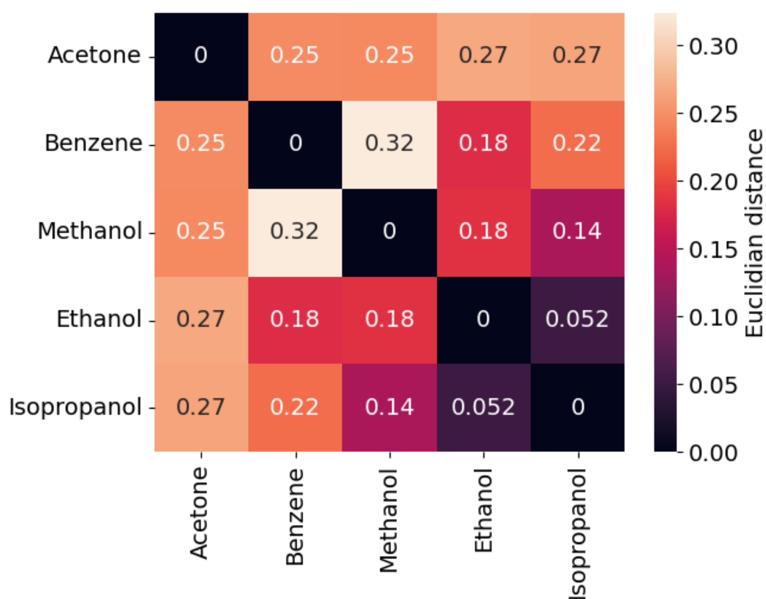

Figure S10. The distances between the clusters of analytes obtained from the “best” combination of materials.

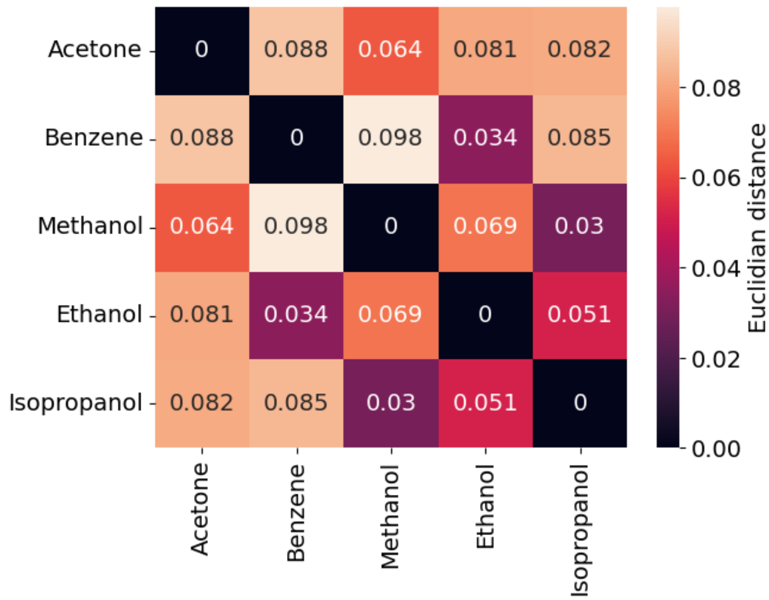

Figure S11. The distances between the clusters of analytes obtained from the "worst" combination of materials.

Table S1. The “best” and the “worst” combinations for specific analytes.

analyte	“best”		“worst”	
	median *M*	combination	median *M*	combination
acetone	0.29	**NiO #1**, **NiO #4**, CeO_2-20%Sm_2O_3, $NiCo_2O_4$, **V_2O_5-50%WO_3**, **ZnO-5.0%Al (5/20)**, **ZnO- 2.5%Al (5/20)**, **V_2O_5-10%WO_3,** ZnO- 1.5%Al (2.5/20)	0.04	Co_3O_4, **NiO #3**, **NiO #4**, **V_2O_5**, **V_2O_5- 5%WO_3**, ZnO-1.5%Al (2.5/20), ZnO-1.5%Al (5/50), ZnO- 0.5%Gd (3.5/25), ZnO- 0.5%Al (5/20)
benzene	0.32	**NiO #2**, **NiO #5**, $NiCo_2O_4$, **V_2O_5**, ZnO-1.5%Zr (80/50), ZnO- 1.5%Al (2.5/20)**,** In_2O_3- 43%SnO_2, **ZnO-5.0%Al (5/20)**, **ZnO- 2.5%Al (5/20)**	0.06	Co_3O_4, **NiO #2**, **NiO #3**, **NiO #4**, **V_2O_5- 50%WO_3**, **V_2O_5- 5%WO_3**, ZnO-1.5%Al (5/50), ZnO-0.5%Al (5/20), ZnO- 0.5%Gd (3.5/25)
methanol	0.29	**NiO #1**, **NiO #2**, **NiO #4**, CeO_2-20%Sm_2O_3, **NiO #5**, $NiCo_2O_4$, **V_2O_5-50%WO_3,** In_2O_3- 43%SnO_2, ZnO-1.5%Zr (80/50)	0.04	Co_3O_4, **NiO #3**, **V_2O_5**, **V_2O_5-10%WO_3**, **V_2O_5-5%WO_3**, ZnO-1.5%Al (2.5/20)**,** ZnO-1.5%Al (5/50), ZnO- 0.5%Gd (3.5/25), ZnO- 0.5%Al (5/20)
ethanol	0.24	**NiO #1**, **NiO #2**, **NiO #4**, CeO_2- 20%Sm_2O_3, **NiO #5**, **ZnO-5.0%Al (5/20)**, **ZnO- 2.5%Al (5/20)**, $NiCo_2O_4$, In_2O_3- 43%SnO_2	0.04	Co_3O_4, **NiO #3**, **V_2O_5**, **V_2O_5-10%WO_3**, **V_2O_5-5%WO_3**, ZnO-1.5%Al (2.5/20)**,** ZnO-1.5%Al (5/50), ZnO- 0.5%Gd (3.5/25), ZnO- 0.5%Al (5/20)
isopropanol	0.29	**NiO #1, NiO #2**, **NiO #4**, CeO_2-20%Sm_2O_3, **NiO #5**, $NiCo_2O_4$ #1, **V_2O_5-50%WO_3**, **ZnO-2.5%Al (5/20)**, In_2O_3-43%SnO_2	0.04	Co_3O_4, **NiO #3**, **V_2O_5**, **V_2O_5-10%WO_3**, **V_2O_5-5%WO_3**, ZnO-1.5%Al (2.5/20), ZnO-1.5%Al (5/50), ZnO- 0.5%Gd (3.5/25), ZnO- 0.5%Al (5/20)